TYPE OF REPORT: Semiannual

TIME PERIOD: Jul-Dec, 1998

NAME AND LOCATION: Alan Strahler, Boston University

CONTRACT NUMBER: NAS5-31369

ABSTRACT -- KEY POINTS

BRDF/ALBEDO

During the reporting period, we focused on primarily on activities for launch readiness. We carried out extensive tests of the at-launch BRDF/Albedo Product code on AVHRR data reformatted to MODAGG specifications. In validation, we participated in the Beltsville Agricultural Research Center measurement campaign led by Dr. Shunlin Liang of the University of Maryland. We added a new part-time postdoctoral researcher to the project. Four journal articles were accepted for publication and two were submitted. Two conference papers with proceedings were submitted and accepted.

LAND COVER/LAND COVER CHANGE

During the second-half of 1998, we concentrated on developing the Landcover Quarterly Product code (Version 2), and in operational testing of our algorithms and scripts using test site data for North America. We demonstrated our ability to generate land cover at a continental-scale using supervised decision tree and neural network classifiers using a database of over 1000 training and validation sites developed for that purpose.

TASK PROGRESS

BRDF/ALBEDO PRODUCT

Personnel

Dr. Feng Gao has joined Dr. Trevor Tsang as postdoctoral researchers with the effort. Both are part-time on the MODIS effort. Dr. Wolfgang Lucht left the group at the end of the year for a position at the Potsdam-Institut fur Klimafolgenforschung. He will remain an Associate Team Member and will continue to collaborate closely. Dr. Crystal Schaaf will assume his BRDF/Albedo duties.

Algorithm Development

The MODIS BRDF/Albedo Product code has been extensively tested on continental AVHRR data which has been reprojected, tiled and reformatted to serve as surrogate input MODAGG data.

An entirely revamped version of the science grade Ambrals code was prepared and released to the community. It now includes (among the 32 kernels that can be used) the reciprocal versions of the Li kernels (as used in the MODIS code) and the Cox and Munk kernel, improved documentation, and simplified QA and output formats.

A postprocessor to easily transfer data already formatted for the science grade Ambrals code to the format necessary for the MODIS BRDF/Albedo Product code has been developed so that additional data can be used to test the operational processing code.

Scientific Advances

Initial constraints to limit the kernel parameterizations to positive values have been implemented in the MODIS BRDF/Albedo Product code. Investigations into more sophisticated constraints are underway as are mechanisms to utilize the coefficient of determination in model selection and fitting.

Six months of AVHRR HRPT data from New England has been geolocated, cloud cleared, calibrated, atmospherically corrected and formatted for use with both the MODIS BRDF/Albedo Product code and the science-grade Ambrals code. Initial runs are underway to investigate the temporal behavior of the BRDF and albedo retrievals.

A month of AVHRR LAC data from North America (which arrived from EDC already geolocated and bulk corrected) has been cloud cleared and formatted for use with the MODIS BRDF/Albedo Product code. The data overlap with the period available for New England. Extensive runs are underway to not only exercise the code but to investigate the spatial variability of the BRDF and albedo retrievals.

An active dialog on the use of the BRDF/Albedo product in land surface modeling has been underway with R. Dickinson (IDS Member) at the University of Arizona. Sample inputs, outputs and code have been provided and Dr. Lucht visited the group to discuss collaboration and encourage use of our product by the climate modeling community in the postlaunch era.

Validation Activities

Involved in discussions and planning with Dr. Huete (U. of Arizona) for MQUALS light aircraft albedo data acquisition in support of postlaunch MODIS validation. Initial tests of the aircraft mounted albedometers were conducted this fall at the Maricopa field site.

Dr. Lucht contributed to the design of the field campaign at the USDA-BARC site in August. He then participated during the intensive data collection phase by collecting albedometer information. This campaign is spearheaded by Dr. Shunlin Liang, the MODIS albedo validation scientist.

An initial draft of the Validation Protocol Document has been completed and is being reviewed by validation scientists in collaboration with Rachel Pinker (who is also participating in the MQUALS efforts).

LAND COVER/LAND-COVER CHANGE PRODUCTS

During this reporting period, The Landcover Quarterly Product code (Version 2) was developed and delivered to SDST on 22 December 1998. Algorithm testing was performed using our North America site database. We continued our work with advanced technology (AT) neural nets and decision trees classifiers. Algorithm testing was performed using our North America Regional database.

Test Sites and Test Site Activities

We continued the development and testing of a land surface parameterdata base derived from Landsat TM and ancillary sources, concentrating on North America. We completed the development and documentation of our validation and test site database.

Algorithm Development and Testing

We continued research on neural net classifiers focusing on operational processing scenarios. We continued processing of AVHRR, TM and ancillary data for this regional test site, and development of a land surface parameter database.

The Decision Tree classifier was implemented in a fully automated script which handles training, testing and classification. The NN (Fuzzy ARTMAP) was also implemented as an ancilliary classifier as well as a MLC and a one-Nearest Neighbor.

Coding/Processing

The MODIS code was revised to incorporate HDF-EOS and to implement ECS mandated changes to the metadata. We expended some effort on tools for reprojecting to the MODIS Integerized Sinusoidal Grid.

We continue to develop tools, scripts and code for integrating our site train/test data with MODIS data, using AVHRR as a surrogate. AVHRR input data as well as training site information were reprojected in Integerized Sinusoidal Projection and tiled in the MODIS grid so that the MODIS processing scenario could be duplicated. We also coordinated with UMD so that the specification

format of the Landcover Quarterly Product exactly matched the format of the at-Launch Landcover Product.

The Landcover Quarterly Product code (Version 2) was developed throughout the period and delivered to SDST on 22 December 98. The code takes fully trained trees and applies them to twelve months worth of monthly MODIS data. New metadata requirements and new SDST toolkit versions were implemented (Crystal and Feng).

We continued to analyze the operational aspects of PI Processing including newtork, computational and storage capacities.

DAAC Activities

BU continues to prototype links with the EDC-DAAC, including remote preprocessing of Landsat test site data for training site development.

Land Cover Change

In Land-Cover Change, we are continuing the development of case studies for 16 land-cover change sites in Africa. We are also working on the interannual variability of land-cover indicators at coarse spatial resolution for Africa using change vector analysis.

BU Land Cover / Land-Cover Change Workshop ----------

Boston University hosted our annual Land Cover / Land-Cover Change Workshop on 14 and 15 October 1998. The workshop was attended by over 30 individuals representing various international institutions involved in land cover issues.

oWe further assisted in hosting the LAI/FPAR/NPP Validation workshop held at Boston University on 12-13 October 1998.

Participation in MODIS Activities

We hosted a meeting with David Roy to discuss LC QA plans in August. We also participated in the IGBP Core Validation Exercise at USGS-EDC, Sioux Falls from 6-14 September 1998. We attended the MODLAND-SDST Meeting, 8-9 September 1998, GSFC.

We attended the MODIS Science Team meeting, 15-18 December 1998 at U. of Maryland - CP. A. Strahler presented the MODLAND surface energy suite of products, and we contributed to the land cover / land-cover change products presentation of J. Townshend.

Deliveries

The Landcover Quarterly Product code (Version 2) was delivered to SDST on 22 December 98.

PUBLICATIONS AND PRESENTATIONS

BRDF/ALBEDO

* A paper on the coupling between surface BRDF and atmospheric correction was accepted for publication by IEEE TGARS --- revisions have been completed and publication is expected in March 99:

Hu, B., W. Lucht, and A. H. Strahler. The interrelationship of atmospheric correction of reflectances and surface BRDF retrieval: A sensitivity study IEEE Trans. Geosci. Remote Sens., in press, 1998.

* A paper on BRDF-corrected NDVI and albedo from AVHRR observations over South America has been accepted by RSE and revisions are underway:

Hu, B., W. Lucht, A. Strahler, C. Schaaf, and M. Smith. Surface albedos and angle-corrected NDVI from AVHRR observations over South America: Remote Sensing of Environment, in revision.

* A paper on the noise sensitivity of MODIS BRDF/albedo retrievals has been accepted by IJRS and revisions have been completed:

Lucht, W., and P. Lewis. Theoretical noise sensitivity of BRDF and albedo retrieval from the EOS-MODIS and MISR sensors with respect to angular sampling: International Journal of Remote Sensing, in press.

* A paper on prototyping of the MODIS BRDF/albedo algorithm was accepted for publication by JGR and revisions have been completed:

d'Entremont, R. E., C. L. Barker Schaaf, W. Lucht, and Alan H. Strahler. Retrieval of red spectral albedo and bidirectional reflectance using AVHRR HRPT and GOES satellite observations of the New England region: Journal of Geophysical Research, in press.

* A definitive paper describing the scientific basis of the at launch MODIS BRDF/Albedo algorithm has been submitted to IEEE TGARS.

Lucht, W., C.B. Schaaf, and A.H. Strahler. An Algorithm for the retrieval of albedo from space using semiempirical BRDF models: IEEE Transactions on Remote Sensing and Geoscicence, in review.

* A paper describing the PROVE albedo validation efforts at Jornada has been submitted to Remote Sensing Environment

Hyman, A. H., W. Lucht, A. H. Strahler, and M. J. Barnsley, A comparison of satellite-derived spectral albedos to ground-based broadband albedo measurements modelled to satellite spatial scale for a semi-desert landscape, Remote Sensing of Environment, in review.

* A paper for the Proceedings of the Workshop on Optical Remote Sensing Terrestrial Surfaces (Finland, Sept 1997) has been submitted.

Lucht, W., C.B. Schaaf, A.H. Strahler, and R.P. d'Entremont. Remote sensing of albedo using the BRDF in relation to land surface properties. Proceedings of the Workshop on Optical Remote Sensing Terrestrial Surfaces (Finland, Sept 1997), in review.

* A paper has submitted and accepted to the proceedings of the ALPS99 International conference and workshops on the contribution of POLDER and new generation spaceborne sensors to global change studies

Lucht, W., C.B. Schaaf, and A.H. Strahler. BRDF and albedo retrieval from space in relation to land surface modeling: Proceedings ALPS99, in press.

* PI and Drs. Lucht and Schaaf chaired sessions and presented overviews at the International Forum on BRDF in San Francisco. Participated in numerous other sessions as panel contributors.

* Extensive involvement in Landcover and LAI/FPAR Workshops held at BU in October.

LAND COVER/LAND COVER CHANGE

Published

Borak, J.S., Lambin, E.F. and Strahler, A.H. (1998). Detection and Validation of Land-Cover Change at Coarse Spatial Scales in Africa. Proceedings of the International Geoscience and Remote Sensing Symposium, July 6-10, 1998, Seattle, WA, Volume V, pp. 2518-2520.

Justice, C., Vermote, E., Townshend, J., et al., 1998, The Moderate Resolution Imaging Spectroradiometer (MODIS): land remote sensing for global change research. IEEE Transactions on Geoscience and Remote Sensing, 36, 1228-1249.

Muchoney. D.M., and A. Strahler. 1998. Developing Vegetation and Land Surface Parameters Using Classification Approaches. Proceedings of the 1998 International Geoscience and Remote Sensing Symposium, 6-10 July 1998, Vol.4, 2112-2114.

In Press

Muchoney. D.M., J. Borak, H. Chi, M. Friedl, J. Hodges, N. Morrow and A. Strahler. 1998. Application of the MODIS Global Supervised Classification Model to Vegetation and Land Cover Mapping of Central America. In Press, International Journal of Remote Sensing).

M. A. Friedl, C. E. Brodley and A. H. Strahler, Maximizing Land Cover Classification Accuracies Produced by Decision Trees at Continental to Global Scales. In press. IEEE Transactions on Geoscience and Remote Sensing.

Submitted

Mark Friedl, Curtis Woodcock, Suchi Gopal, Doug Muchoney, Alan H. Strahler and Crystal Barker-Schaaf, Note on Procedures Used for Accuracy Assessment in Land Cover Maps Derived from AVHRR Data, submitted to Remote Sensing Letters, International Journal of Remote Sensing.

Borak, J., E. Lambin and A. Strahler. The Use of Temporal Metrics for Land-Cover Change Detection at Coarse Spatial Scales. Submitted to International Journal of Remote Sensing.

PAPERS PRESENTED

"Developing Vegetation and Land Surface Parameters Using Classification Approaches" presented at Proceedings of the 1998 International Geoscience and Remote Sensing Symposium, 6-10 July 1998 (D. Muchoney).

"Generation of surface biophysical parameters for global vegetation and land cover characterization using MODIS data." presented at the Annual Meeting of the Ecological Society of America, Baltimore MD, 3-6 August 1998 (D. Muchoney).

PROBLEMS/CORRECTIVE ACTIONS

During this reporting period, we did not encounter any significant problems requiring corrective actions.

ANTICIPATED ACTIVITIES DURING THE NEXT QUARTER

BRDF/ALBEDO

* Deliver a version 2.1 BRDF/Albedo Product code by 1 April which

will include improved parameter constraints and mandated metadata.

* Complete prototyping of MODIS processing by using AVHRR data.

* Prepare journal articles describing prototyping efforts
prior to launch.

* Update BRDF/Albedo ATBD.

* Participate in WILT/MODAPPS testing.

LAND COVER/LAND COVER CHANGE

* Continue to focus on algorithm testing in North America.
Classification algorithm development and testing will focus on the operational aspects (process, flow) of neural net and decision trees classifiers. We will expand test activities to developing a global test site database based on the 400 IGBP Core sites and the 30 MODLAND Core test sites.

* Improve automated classifier scripts to handle MODIS monthly
file formats (HDF-EOS, QA, data formats).

* Test processing chain by using AVHRR data that has been
converted to nadir reflectances through the BRDF/Albedo Product code, has been formated with the Monthly Landcover code, a subset of which interacts with the classification train and test scripts to produce a fully trained tree that is applied to the entire data set with the Quarterly Landcover Product code.

* Deliver a new version of Landcover Monthly Code with minor
metadata and QA enhancements by 1 April 99.

* New ATBD information: We will update the Land Cover Change Algortihm
Theoretical Basis Document (ATBD) during this period.

* In land cover change activities, continue testing of change vector
and neural network change detection techniques at specific sites to complement the multitemporal nature of the land cover activities. We will complete the land-cover change case studies and the interannual variability work, and write up the results of both activities.